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## (54) AN ELECTRICAL CONNECTOR

(71) I, VANE MARK SUTTON-VANE, of 34 Royal Crescent, London, W11 4SN, a British Subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in or relating to the making of an electrical connection to an insulated conductor. The invention is applicable to any situation where an electrical connection is to be made to an insulated conductor, and finds particular application in connectors for electrically interconnecting a plurality of insulated conductors and in electrical plugs for cables comprising a plurality of insulated conductors.

Known connectors or plugs for insulated conductors usually employ a terminal provided with a threaded clamping member for captively securing a stripped end portion of a conductor to an electrically conducting body of the terminal. One example of such a known terminal comprises a bored block or sleeve into which the stripped end of the insulated conductor is inserted, and a terminal screw extending transversely into the bore of the block or sleeve for clamping the stripped end of the conductor in the bore. Another known terminal construction comprises a threaded terminal post around which a stripped end of the insulated conductor is wrapped, and a clamping nut which is screwed onto the post to clamp the end of the conductor between the nut and a radial contact surface from which the threaded post extends.

It is a disadvantage of these known terminals that an end portion of the conductors has to be stripped of its insulation, since this may result in damage to the conductor and its insulation beyond the stripped portion if carried out inexpertly. Moreover, the end of the conductor must be properly applied to the terminal and the movable parts of the terminal must be properly tightened if a satisfactory and safe connection is to be established. Where a plurality of the known terminals are employed in a connector or in a

plug, a time consuming connecting operation must be carried out separately in respect of each terminal.

According to the present invention there is provided an electrical terminal for making an electrical connection to an insulated conductor, comprising a base, a cover, and means to secure the cover to the base, an electrically conducting terminal body being mounted on the base and having a contact surface and an electrically conducting spike projecting from the contact surface towards the cover, the base having means for locating a portion of the insulated conductor in a position to overlie the contact surface and for guiding such conductor portion for movement transversely of the conductor towards the contact surface of the terminal body, the cover carrying means for pressing the insulated conductor onto the contact surface of the terminal body as the cover is secured to the base so as to cause the spike to penetrate the insulation of the conductor transversely of the conductor to establish an electrical connection between the terminal body and the conductor.

According to a preferred feature of the invention, the contact surface is substantially planar and the spike extends substantially perpendicularly to the contact surface.

The terminal body may comprise a sheet metal member, the spike being stamped out of the material of the sheet member.

Preferably a plurality of electrically conducting spikes project from the contact surface of the terminal body.

Desirably, the base is made of an electrically insulating material. The locating and guiding means may then comprise side walls a channel in the base, the terminal body being mounted in the channel.

The pressing means may conveniently comprise a plunger carried by the cover and engageable in the channel of the base and movable into the channel into a contact-establishing position.

In one embodiment of the invention, the plunger is formed with a serrated surface for engaging and gripping a wall of the channel to retain the plunger in its contact-establish-

ing position. Advantageously, a side wall of the channel is provided with a groove in which a serration of the serrated surface of the plunger is engageable.

5 In a preferred form of the invention, the cover is made of an electrically insulating material and in this case, the plunger may be integrally formed with the cover.

10 The means for securing the cover to the base may comprise a screw extending freely through a passage in the base or cover for threaded engagement with a threaded passage in the cover or base.

15 The present invention also provides an electrical connector for connecting a plurality of insulated electrical conductors together, which connector comprises a plurality of terminals according to the invention, each terminal being for connection to a  
20 respective one of the conductors, the terminal bodies of the terminals being electrically interconnected.

25 In a conductor embodying the invention for interconnecting first and second insulated electrical conductors, first and second terminal bodies of respective first and second terminals may be mounted in a common channel provided in a common electrically insulating base. First and second plungers for pressing the respective conductors onto the  
30 contact surfaces of the first and second terminal bodies may be parts of a common cover for attachment to the common base.

35 An electrically insulating divider may extend transversely of the common channel to divide the channel into first and second sections for receiving end portions of the first and second conductors respectively.

40 A plurality of connectors embodying the present invention may have their bases connected together to form a connector strip. If desired, the connections between the bases of the connectors may be frangible to enable connectors to be separated from the strip.

45 The present invention further provides an electrical plug for a cable comprising a plurality of insulated conductors, which plug comprises a plurality of terminals according to the invention, each terminal being for  
50 connection to a respective insulated conductor and having its terminal body electrically connected to a respective pin of the plug.

55 The terminal body of each terminal is preferably mounted in a respective channel formed in a common electrically insulating base, each channel being for receiving an end portion of a respective insulated conductor.

60 In a plug embodying the invention, a plurality of plungers for pressing the respective conductors onto the contact surfaces of the terminal bodies may be carried by a common cover for attachment to the common base.

65 Preferably, a plug embodying the present invention comprises a cable grip. The cable

grip may comprise a grip bar releasably secured to the base by a single fastener to overlie a cable entry recess formed in the base.

70 In order that the invention may be readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

75 FIGURE 1 is a fragmentary perspective view of an electrical connector strip embodying the invention;

80 FIGURE 2 is a top plan view of a base part of the three-pin electrical plug embodying the invention;

FIGURE 3 is a cross-sectional view taken on the line III--III of Figure 2, the cable grip and its retaining screw being omitted for clarity;

85 FIGURE 4 is a bottom plan view of the base part of the plug shown in Figure 2;

FIGURE 5 is a bottom plan view of a cover of the plug embodying the invention;

90 FIGURE 6 is a cross-sectional view taken on the line VI--VI of Figure 5;

FIGURE 7 is a cross-sectional view taken on the line VII--VII of Figure 5; and

95 FIGURE 8 is a schematic cross-sectional view through another 3-pin electrical plug embodying the invention.

Referring to Figure 1, an electrical connector strip embodying the invention comprises a plurality of individual identical connectors 1, three of which are shown in the Figure. The connectors 1 are linked together to form  
100 a strip but are electrically separate, each connector being for electrically interconnecting a respective pair of insulated electrical conductors. Each connector 1 comprises a base 2 and a cover 14 which are made of an  
105 electrically insulating material, for example a synthetic plastics material such as nylon.

The base 2 of a connector 1 defines a channel 3 which has a rectangular cross-section and is open at both ends, the base 2  
110 having parallel side walls 4 and 5 interconnected at lower edges thereof by a floor 6. An integrally formed divider block 7 extends from the inside surface of side wall 5 and the floor into the channel 3 and defines with the  
115 floor and the inside surface of the side wall 4 a constricted channel portion 8 between first and second end sections of the channel 7. The divider block 7 terminates short of the  
120 upper edges of the side walls 4 and 5 and is formed with a threaded blind bore 9 extending into the block 7 from the upper surface thereof perpendicular to the floor 6 of the base 2. Vertically extending part-cylindrical  
125 recesses 10 may be formed in the outside surfaces of the side walls 4 and 5 at the location of the divider block 7 to facilitate handling of the connector 1.

Located on the floor 6 of the base 2, adjacent to respective sides of the divider 130

block 7, are two identical electrically conducting terminal bodies 11, only one of which is visible in Figure 1. Each terminal body is substantially rectangular and extends across the whole width of the floor 6 but terminates short of the respective open end of the channel 3. The two terminal bodies 11 are constructed from a single metal, e.g. brass, plate and are interconnected by an integral connecting strip 12 received in the constricted channel portion 8. Each terminal body has a contact surface 13 from which projects a plurality of electrically conducting spikes 23 suitably constructed from the same material as the terminal bodies 11 and extending perpendicular to the contact surface 13.

The cover 14 comprises a substantially rectangular strip dimensioned to be received within the channel 3 substantially parallel to the floor 6 of the base 2. End portions 15 and 16 of the cover 14 project below the recessed bottom surface 17 of a central portion 18 of the cover 14 to constitute two plungers each having a pressure surface 19. The central cover portion 18 is apertured to receive a screw 20 for screwing into the bore 9 to secure the cover 14 and base 2 together and to make the electrical connection between end portions of insulated conductors placed in channel 3 as hereinafter described.

Adjacent side walls 4 and 5 of the bases 2 in the connector strip are connected together by four links 21, which are arranged symmetrically in two pairs, one on each side of the recess 10 of the base side wall. The links may be integrally formed with the side walls of the bases 2 and may be made easily frangible to enable a desired number of connectors to be broken off from the strip.

A connector 1 of the connector strip shown in Figure 1 may be used to establish an electrical connection between a pair of conductors 22 having a pierceable insulation, for example the individual insulation of the conductors of a double-insulated two or three conductor cable. To establish such a connection, the cover 14 is removed from the base 2 of the connector and an unstripped end portion of each of the conductors 22 is laid into the channel 3 on a respective side of the divider block 7 so as to overlie a respective one of the terminal bodies 11. The conductor end portion 11 is located and guided by the side walls 4 and 5 of the base 2 for movement transversely of its length towards the contact surface of the terminal body 11. The cover 14 is then applied to the base 2, the screw 20 is located in the bore 9, and the screw then tightened to draw the cover 14 into the channel 3. Tightening of the screw causes the end portion of each conductor 22 to be pressed, by the respective pressure surface 19 of the cover 14, onto the contact surface 13 of the respective terminal

body 11 so that the spikes 23 penetrate the insulation of the conductor 22 transversely of the conductor to establish and maintain an electrical connection between the terminal body and the conductor.

Referring to Figures 2 to 7, a three-pin 13 amp electrical plug embodying the invention comprises a base 31 and a cover 32 which are made of electrically insulating material, for example a synthetic plastics material such as nylon.

The base 31 supports a live pin 33, a neutral pin 34 and an earth pin 35 which project from the lower surface of the base 31 through respective rectangular apertures 36, 37 and 38.

An elongate cable entry recess 39 of the base 31 leads to three channels 40, 41 and 42 of rectangular cross-section for receiving end portions of respective conductors of a double-insulated three-conductor cable (not shown) to be connected to the plug. The first channel 40, which extends at an angle to the recess 39, is for the neutral conductor of the cable and communicates via a branch channel 43 with the neutral pin aperture 37. The second channel 41 is for the earth conductor of the cable and extends substantially in the longitudinal direction of the recess 39, the earth pin aperture 38 being formed in the floor of channel 41. The third channel 42, which is angled relative to the recess 39 in the opposite direction to channel 40, is for the live conductor of the cable and communicates with the live pin aperture 36 via a branch channel 44 and a fuse recess 45.

A cable grip bar 46 is mounted by a screw 47 at the inlet end of the cable entry recess 39 so as transversely to overlie the recess 39. The grip bar 46 is mounted in a recess 48 having a floor 49 which slopes towards the recess 39. The mounting screw 47 extends through a bore 50 and has its head received in a recess 51 in the bottom surface 52 of the base 31. A ledge 53 formed at the junction of recess 51 and bore 50 forms a stop for the screw head.

The plug comprises a neutral terminal body 54, an earth terminal body 55 and a live terminal body 56, each in the form of a metal, e.g. brass, plate. The neutral terminal body 54, which is substantially L-shaped, is attached to neutral pin 34, such as by soldering or brazing at 57, and extends along the floor of branch channel 43 into the channel 40, where the terminal body presents a rectangular contact surface 58. The earth terminal body 55, which is substantially rectangular, is attached to earth pin 35, such as by soldering or brazing at 59, and extends along the floor of the channel 41 in which it presents a contact surface 60. The live terminal body 56 comprises first and second rectangular portions 61 and 62 respectively disposed on the floors of channel 42 and fuse recess 45 and interconnected by a connecting

strip 63 in branch channel 44. Portion 61 of terminal body 56 presents a contact surface 64 and portion 62, which is secured to base 31 at 65, constitutes a clip member carrying a pair of clip arms 66 which, together with corresponding arms 67 on a clip member 68 secured to live pin 33 form a fuse clip for a cartridge type fuse (not shown).

Each of the contact surfaces 58, 60 and 64 has a plurality of spikes 69 projecting therefrom perpendicular to the contact surface.

The plug cover 32 shown in Figures 5 to 7 is adapted to be connected to the base 31 by a securing screw (not shown) passing through a plain aperture 70 in the base 31 and engaged in a threaded fastener 71 fixed to cover 32 in a blind bore of the cover. The securing screw may be captively retained in the base 31 in known manner to avoid loss.

The cover 32 comprises an L-shaped recess 72 from the floor of which project a first low lug 73 for engaging a fuse mounted in the fuse recess 45 of base 31, and a second higher locating lug 74 for engaging in the neutral pin aperture 37. A land 75 of the cover 32 carries projecting integrally formed plungers 76, 77 and 78 for engaging respectively in the channels 40, 41 and 42 when the cover 32 is applied to the base 31.

To connect a three-conductor double-insulated cable or flex to the above described plug, an end portion of the outer insulating sheath is removed to expose end portions of the individual insulated conductors with their insulation intact. The cover 32 and base 31 of the plug are disconnected by unscrewing the connecting screw. The grip bar is released, by unscrewing its mounting screw, sufficiently for the end of the cable to be pushed beneath the grip bar into the cable entry recess and the end portions of the individual insulated conductors are laid in the respective channels 40 to 42 with the ends of the conductors touching the ends of the channels. The mounting screw of the grip bar is then tightened up to grip the cable firmly. The cover 32 is next applied to the base 31, so that the locating lug 74 engages in the neutral pin aperture 37 above the neutral terminal body and the plungers 76 to 78 engage in the respective channels 40-42. Upon firmly tightening up the securing screw to draw the base 31 and cover 32 together, each plunger 70 to 78 presses the insulated conductor in the respective channel 40-42 onto the contact surface of the respective terminal body so that the spikes 69 penetrate the insulation of the conductor transversely of the conductor to establish an electrical connection between the terminal body and the conductor.

Figure 8 illustrates schematically a second embodiment of a three-pin plug according to the invention, in which plungers 80 integrally formed on a cover 81 of the plug are

provided with serrations 82 for engaging and gripping the side walls of channels 83 in the plug base 84. Each of the side walls of a channel 83 has a groove 85 for co-operating with the serrations 82 to retain a plunger forced into the channel. To establish an electrical connection using the Figure 8 embodiment, the cable is inserted in the channels of the base 84 as for the embodiment of Figures 2 to 7 and the cover 81 is hammered onto the base 84, forcing the plungers 80 into the channels 83 and pressing the conductors of the cable onto the contact surfaces of the respective terminal bodies. A similar construction could also be applied to the connectors of Figure 1 and to single terminals embodying the invention.

It is envisaged that, in a modification of the Figure 8 embodiment, the plungers themselves could have a smooth surface and additional serrated connecting bosses could be provided on the cover for co-operation with grooved bores in the base in a similar way to the co-operation of the of the plungers 80 and channels 83 in Figure 8. The use of serrated plungers or connecting bosses could also be used in combination with the use of a securing screw as used in the embodiment of Figures 2 to 7.

Many modifications may be made in the described embodiments of the invention without departing from the scope of the invention as defined in the claims. For example, the cover of a connector or plug embodying the invention may be hingeably mounted on the base of the connector or plug and, if the cover and base are made of suitable material such as polypropylene, the hinge may be integrally formed with the cover and base.

Although a particular form of cable grip having one mounting screw has been described in relation to the plug of Figures 2 to 7, any suitable cable grip could be used and in particular a cable grip having two mounting screws fixing a cable bar on both sides of the cable entry recess. Moreover, the cable grip may be situated in a different position, for example between the neutral and live pins so as to provide a very compact plug.

The members which penetrate the conductor insulation, which members are termed "spikes" in this Specification, may have a different shape from that illustrated in the drawings, although it is essential that the members have a sharp surface so positioned as to penetrate the conductor insulation when the cover is connected to the base.

Further, the contact surfaces of the terminal bodies may be differently located in the channels and the channels may have a constricted upper region, for example by providing inwardly projecting lugs on the inside surfaces of the channel side walls so that a conductor pressed into the channel

past the constricted region will be retained in position in the channel until the cover is applied to press the conductor onto the terminal body.

#### WHAT I CLAIM IS:—

1. An electrical terminal for making an electrical connection to an insulated conductor, comprising a base, a cover, and means to secure the cover to the base, an electrically conducting terminal body being mounted on the base and having a contact surface and an electrically conducting spike projecting from the contact surface towards the cover, the base having means for locating a portion of the insulated conductor in a position to overlie the contact surface and for guiding such conductor portion for movement transversely of the conductor towards the contact surface of the terminal body, the cover carrying means for pressing the insulated conductor onto the contact surface of the terminal body as the cover is secured to the base so as to cause the spike to penetrate the insulation of the conductor transversely of the conductor to establish an electrical connection between the terminal body and the conductor.

2. A terminal according to claim 1, wherein the contact surface is substantially planar and the spike extends substantially perpendicular to the contact surface.

3. A terminal according to claim 1 or 2, wherein the terminal body comprises a sheet metal member and the spike is stamped out of the material of the sheet member.

4. A terminal according to any one of claims 1 to 3, wherein a plurality of electrically conducting spikes project from the contact surface of the terminal body.

5. A terminal according to any one of the preceding claims, in which the base is made of an electrically insulating material.

6. A terminal according to any preceding claim, wherein the locating and guiding means comprises side walls of a channel in the base, the terminal body being mounted in the channel.

7. A terminal according to claim 6, wherein the pressing means comprises a plunger carried by the cover and engageable in the channel of the base and movable into the channel into a contact-establishing position.

8. A terminal according to claim 7, wherein the plunger is formed with a serrated surface for engaging and gripping a wall of the channel to retain the plunger in its contact-establishing position.

9. A terminal according to claim 8, wherein a side wall of the channel is provided with a groove in which a serration of the serrated surface of the plunger is engageable.

10. A terminal according to any one of

the preceding claims, in which the cover is made of an electrically insulating material.

11. A terminal according to any of claims 7 to 9, and claim 10, wherein the plunger is integrally formed on the cover.

12. A terminal according any preceding claim, wherein the means for securing the cover to the base comprises a screw extending freely through a passage in the base or cover for threaded engagement with a threaded passage in the cover or base.

13. An electrical connector for connecting a plurality of insulated electrical conductors together, comprising a plurality of terminals according to any preceding claim, each terminal being for connection to a respective one of the conductors, the terminal bodies of the terminals being electrically interconnected.

14. A connector according to claim 13, for interconnecting first and second insulated electrical conductors, wherein first and second terminal bodies of respective first and second terminals are mounted in a common channel provided in a common electrically insulating base.

15. A connector according to claim 14, wherein first and second plungers for pressing the respective conductors onto the contact surfaces of the first and second terminal bodies are parts of a common cover for attachment to the common base.

16. A connector according to claim 14 or 15, comprising an electrically insulating divider extending transversely of the common channel to divide the channel into first and second sections for receiving end portions of the first and second conductors respectively.

17. A connector strip comprising a plurality of connectors according to any one of claims 14 to 16 having their bases connected together.

18. A connector strip according to claim 17, wherein the connections between the bases of the connectors are frangible to enable connectors to be separated from the strip.

19. An electrical plug for a cable comprising a plurality of insulated conductors, which plug comprises a plurality of terminals according to any one of claims 1 to 12, each terminal being for connection to a respective insulated conductor and having its terminal body electrically connected to a respective pin of the plug.

20. A plug according to claim 19, wherein the terminal body of each terminal is mounted in a respective channel formed in a common electrically insulating base, each channel being for receiving an end portion of a respective insulated conductor.

21. A plug according to claim 20, wherein a plurality of plungers for pressing the respective conductors onto the contact surface of the terminal bodies are carried by

a common cover for attachment to the common base.

22. A plug according to any one of claims 20 to 21, and further comprising a cable grip.

23. A plug according to claim 22, wherein the cable grip comprises a grip bar releasably secured to the base by a single fastener to overlie a cable entry recess formed in the base.

24. A plug according to any one of claims 19 to 23 comprising three terminals.

25. An electrical connector substantially as hereinbefore described with reference to the accompanying drawings.

26. An electrical plug substantially as hereinbefore described with reference to the accompanying drawings.

M. SUTTON-VANE.

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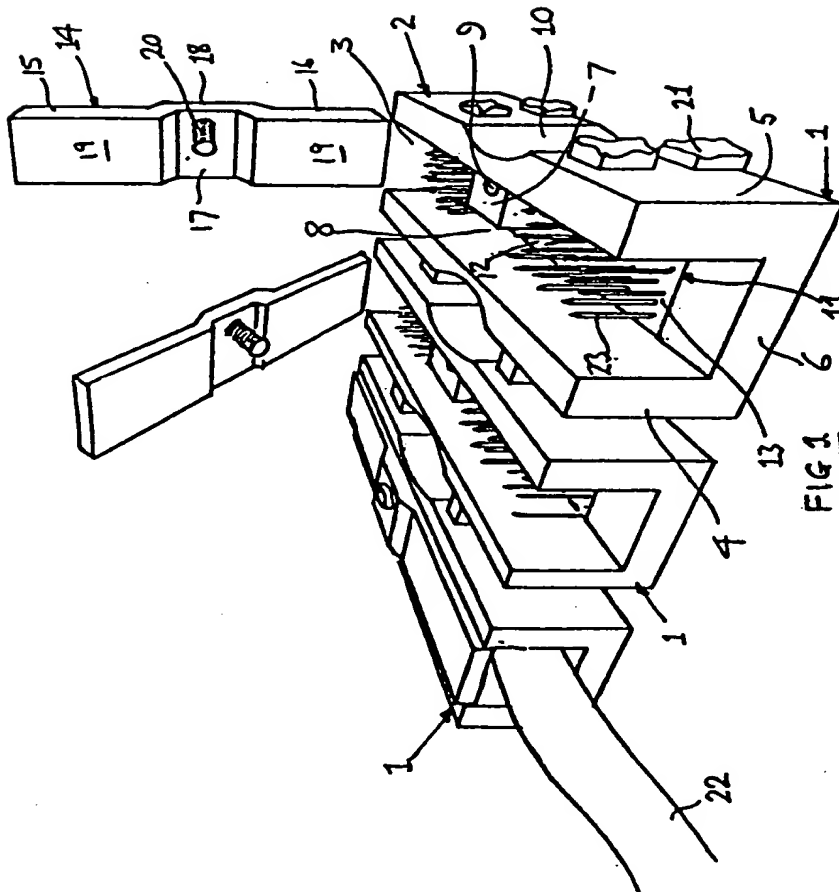
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COMPLETE SPECIFICATION

5 SHEETS

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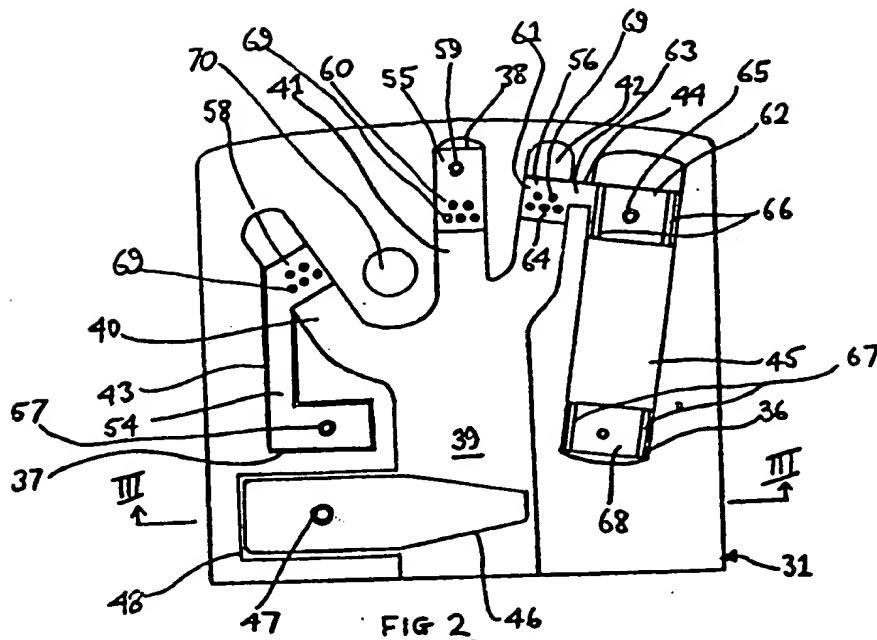
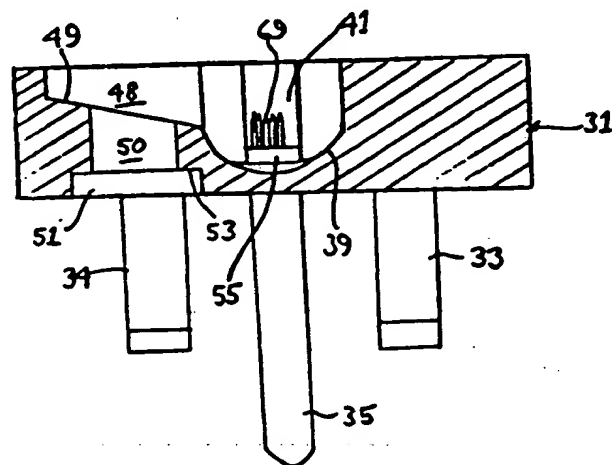
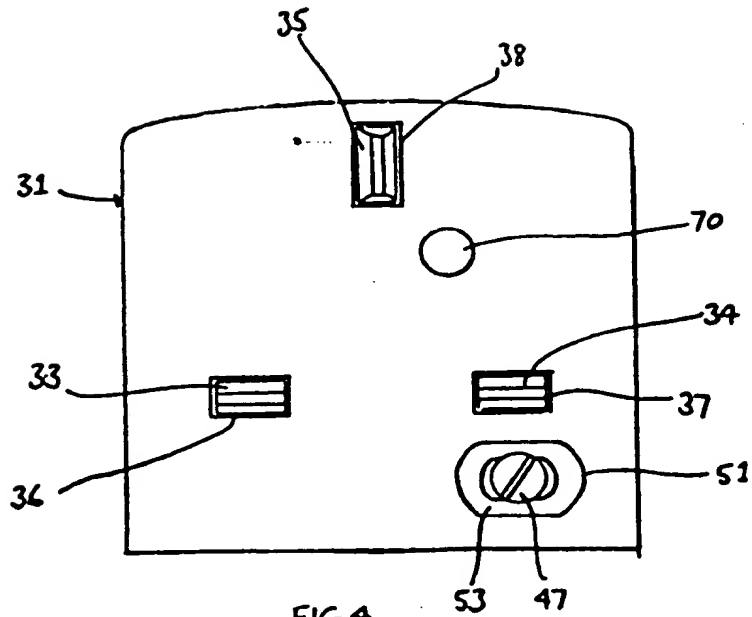
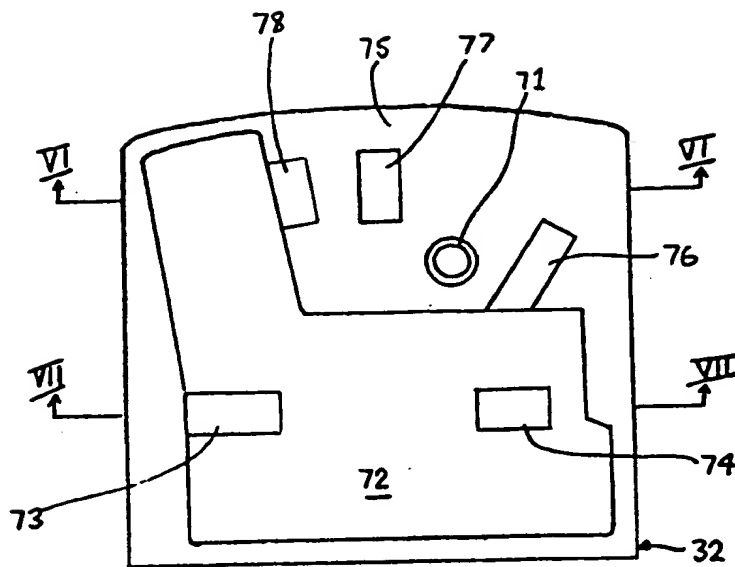
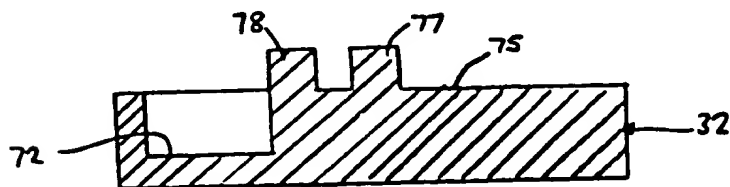
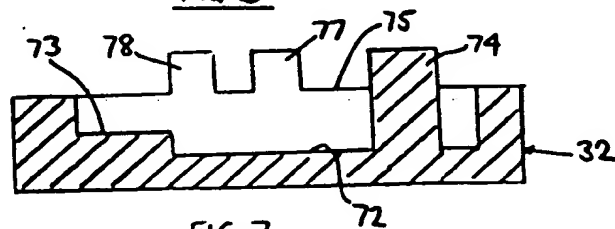


FIG 2 46



**FIG 3**

FIG. 4

FIG. 5FIG. 6FIG. 7

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the Original on a reduced scale*  
Sheet 5

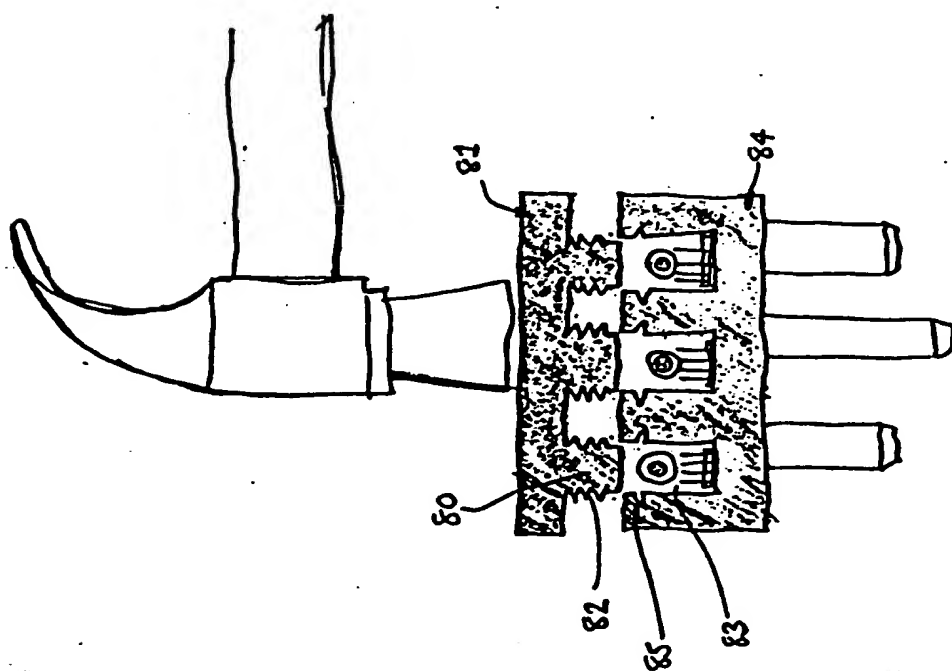


FIG. 8.